

**REMARKS**

Claims 1-26 and 28-35 remain pending. Claims 27 and 36-70 have been canceled, consonant with a restriction requirement that was made by the Examiner. It is believed that the amendments above resolve the Examiner's concerns with respect to § 112. No amendments have been made in view of the prior art of record, since Applicants believe that the claims are patentably distinct, as they stand. In this regard, it is noted that the Examiner indicated that claim 26 would be allowable if rewritten into independent form. Applicants appreciate the Examiner's consideration of the Application.

**The § 103 Rejections**

The Examiner rejected claims 1-25 and 28-35 under 35 U.S.C. § 103(a) as being unpatentable over a publication entitled THE REMOVAL OF MERCURY(II) FROM DILUTE AQUEOUS SOLUTION BY ACTIVATED CARBON by C. P. Huang, et al. (hereinafter Huang) in view of U.S. Patent No. 5,112,428 issued to Correa et al. (hereinafter the '428 patent). Applicants respectfully traverse, as will be discussed below.

Initially considering claim 1, this claim recites:

[I]n a solution having a specific acidic pH and containing metal cations, adding (i) an amphipathic, heterocyclic, metal-coordinating compound and (ii) a sorbent, such that the addition at the specific acidic pH causes at least some of the metal-coordinating compound to bind with some of the metal cations and at least some of the metal-coordinating compound sorbs to the sorbent, along with any metal cations bound therewith.

In attempting to meet these limitations, the Examiner states that Huang discloses removing metal cations from a solution having an acidic pH by adding a metal coordinating compound and a sorbent of the type recited. The Examiner further states that Huang, as a primary reference, discloses the claimed invention except for the type of metal coordinating compound that is used. Applicants respectfully disagree.

The Huang reference, as a whole, is directed to removal of mercury from an aqueous solution using activated carbon. At the bottom of the second column of Huang on page 37, carrying over to the first column on page 38, Huang states that the major objectives of this study were to examine the effect of factors such as pH, carbon type, mercury concentration and complexation on the total removal of mercury(II) from dilute aqueous solutions. However, it was a specific, and thought to be primary, objective of Huang to study metal removal by reduction and adsorption reactions. Hence, reduction and adsorption are Huang's desired mechanisms for metal removal, while the aforementioned factors, including complexation, were merely viewed as having varying incidental effects. It is noted that both reduction and adsorption reactions occur directly between the carbon and the mercury. In this regard, claim 1 is not directed to sorption of metal cations to a sorbent or reduction of the metal using a sorbent, but directly to complexation as a primary mechanism. Specifically, sorption of an amphipathic, heterocyclic metal-coordinating compound to the sorbent, which metal-coordinating compound, in turn, binds the metal. Accordingly, for at least this reason, it is respectfully submitted that Huang is directed, on its face, to a different process that is not reasonably related to the process that is recited by claim 1. For at least this reason, it is respectfully submitted that any rejections relying on Huang should be withdrawn. It is considered that there are additional reasons which compel the patentability of claim 1 over Huang, as will be discussed immediately hereinafter.

On page 44, second column, of Huang, which was cited by the Examiner, a discussion is presented with respect to the effect of complexation. Specifically, there is a reference to one paper which reports, with no reference to pH,

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enhanced adsorption of Hg(II) when using a chelating agent (i.e., metal coordinating compound) such as, for example, EDTA. Another paper, in contrast, reports no effect in an acidic pH, with an inhibitory effect under alkaline conditions. Huang then continues in this column stating:

The results shown in Fig. 11, however, indicate that in the presence of EDTA (at equimolar concentration to Hg(II)), the total Hg(II) removal is less than when EDTA is absent, at least in the pH region from 3 to 7.

In other words, Huang teaches that removal of mercury, in an acidic to neutral pH range, is actually hindered by the presence of EDTA. This conclusion is emphasized in the last paragraph of the reference which states that both adsorption and reduction reactions are reduced when a strong chelating agent, EDTA, is present. Clearly, in Huang's view, complexation produces an adverse effect on the metal removal process. Accordingly, one having ordinary skill in the art would have no motivation to use a metal coordinating compound in order to enhance metal removal in an acidic pH in view of Huang, since the reference teaches against doing so. Specifically, Huang teaches that the use of a strong chelating agent reduces metal sorption potential and overall metal removal at an acidic pH. Hence, for at least this reason, it is submitted that Huang fails, when viewed in any reasonable light, with respect to teaching, disclosing or suggesting the use of a metal coordinating compound for purposes of metal removal from an acidic aqueous solution.

Still considering Huang, it is noted that the term "chelating agent" or "metal coordinating compound" encompasses a broad class of compounds. Chemically, a chelate is a compound that is formed from complexing of cations with organic compounds, resulting in a ring structure. Both EDTA and an amphipathic, heterocyclic, metal-coordinating compound, as recited by claim 1, are within this class. Thus, while EDTA can be broadly characterized as a metal coordinating compound, it is not an amphipathic, heterocyclic, metal-coordinating compound. Applicants have recognized, however, that the recited amphipathic, heterocyclic, metal-coordinating compound behaves in a highly advantageous manner, under the recited circumstances, for purposes of sequestering metal from solution and which is not typical of chelating agents as a whole. What is thought to be the reason for the highly advantageous behavior of this compound, with no intent to be bound by theory, is described in paragraph 17 of Applicants' disclosure.

The Examiner clearly appreciates the distinction between the general class of metal coordinating compounds and the specific characteristics of an amphipathic, heterocyclic, metal-coordinating compound, since the Examiner admits, in the context of making out the § 103 rejection, that Huang fails to teach the use of the metal-coordinating compound of the type recited. The Examiner then relies on the '428 patent as teaching such a compound in attempting to meet the claimed combination. In making out the rejection, the Examiner states:

It would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the metal coordinating compound disclosed in Correa et al. for the metal coordinating compound of the Huang et al. publication, since this secondary reference metal coordinating compound is capable of chelating

metal ions in a solution in substantially the same manner as the metal coordinating compound of the primary reference, produce substantially the same results.

Applicants respectfully disagree. The '428 patent is directed to a process for wet lamination of a layer of photoresist onto a substrate such as a printed circuit board. At column 12, lines 38-60, a heterocyclic compound is described as a wetting agent for preventing "lock-in" of the photoresist layer and for preventing oxidation of a copper layer. Such application is solely for the purpose of surface wetting and inhibiting corrosion, does not involve the use of a conventional solid-phase sorbent, and was not applied for the purpose of immobilizing otherwise free metal ions. Certainly, the use of a heterocyclic compound as a wetting agent teaches nothing with respect to the behavior that Applicants have discovered. It is submitted that the '428 patent, standing on its own and taken as a whole, is not reasonably related to the combined limitations encompassed by claim 1 and has been taken out of context. In this regard, it is impermissible to use the claims as a framework from which to pick and choose among individual, disparate references to recreate the claimed invention. Hence, it is respectfully submitted that the combination of the '428 patent with Huang is not reasonable on its face.

With the foregoing in mind, it is well-settled that in order to make out a proper rejection under § 103, the prior art must itself contain some objective teaching that would lead one of ordinary skill in the art to make the proposed modification. In this regard, Applicants find no teaching in Huang with respect to the advantages discovered by Applicants that are associated with using an amphipathic, heterocyclic, metal-coordinating compound and, in particular, in the context of the mechanism for metal removal that is recited by claim 1. Specifically, the metal coordinating compound (i) binds with the metal cations and (ii) sorbs to the sorbent. Huang, in contrast, teaches that complexation interferes with and reduces metal removal. Accordingly, it is submitted that Huang teaches directly away from the limitations of claim 1.

The '428 patent fails no better with respect to suggesting the proposed substitution, since it teaches the mere use of a heterocyclic compound for applying photoresist. Applicants find no teaching, disclosure or reasonable suggestion in the '428 patent with respect to the use of the heterocyclic compound for removal of metal cations from an aqueous solution, acidic or otherwise. While the '428 patent describes chelation to copper on the circuit board, it is submitted that any metal coordinating compound is capable of performing such chelation, since this is the very nature of all of these compounds, and fails to single out a heterocyclic compound as being any different than metal coordinating compounds in a general sense. Thus, even if the combination is assumed to be reasonable, with which Applicants disagree, the rejection still fails at least for the reason that there is no teaching with respect to making the suggested substitution of the compound of the '428 patent in the process of Huang.

Now considering the suggested combination of references, Applicants find no reasonable teaching, disclosure or suggestion in the '428 patent, or in Huang itself, which would motivate one of ordinary skill in the art to substitute the heterocyclic compound of the '428 patent for the EDTA used by Huang, especially in view of the fact that the introduction of EDTA by Huang produced a detrimental outcome. Further, EDTA has no heterocyclic character and has weak, if any, amphipathic character. The proposed combination is supported through the Examiner's assertion that

substantially the same results are produced. Applicants disagree with this rationale. Applicants are unaware of any provision in the § 103 doctrine which allows motivation for a proposed combination to flow from achieving an outcome that is the opposite of what is desired. Accordingly, it is submitted that the prior art of record, in any reasonable combination, fails to teach, disclose or suggest the use of an amphipathic, heterocyclic, metal-coordinating compound and sorbent, as recited. For at least these reasons, allowance of claim 1 over the art of record is respectfully requested.

Claims 2-25 each depend either directly or indirectly from and therefore include the limitations of claim 1. Accordingly, it is respectfully submitted that each of these claims is also patentable over the art of record for at least the reasons set forth above with respect to claim 1. Further, each of these dependent claims places additional limitations on their parent and intermediate claims which, when considered in light of claim 1, further distinguish the claimed invention from the art of record.

For example, claim 3 recites that the metal-coordinating compound includes a binding portion containing a plurality of heteroatoms and a hydrophobic portion for sorbing to the sorbent.

As another example, claim 4 recites that the metal-coordinating compound is selected from the group consisting of a benzotriazole and a benzothiazole. While the '428 patent discloses the use of these compounds, it is for an entirely unrelated purpose. Moreover, as discussed above, the proposed combination with Huang is considered as unreasonable.

As still another example, claim 5 recites that the specific pH is in a range from approximately pH 2 to pH 6 and the metal-coordinating compound is Benzotriazole, Benzothiazole or Methylbenzotriazole. In this pH range, Huang reports reduced metal removal, thereby teaching away from the claimed subject matter.

As a continuing example, claim 6 recites that the sorbent is an H type activated carbon.

As a further example, claim 7 recites an extremely acidic environment in which the specific pH is less than approximately 2. Again, Huang teaches reduced metal removal efficiency in acidic environments and there is no reason not to assume that metal removal would be even further lessened in such a depressed pH – since it is the process variable isolated by Huang. Claim 8 depends from claim 7 and recites that the metal-coordinating compound is selected as at least one of carboxybenzotriazole, any fatty acid conjugated benzotriazole derivative, butylbenzotriazole, other aliphatic conjugated benzotriazole and benzothiazole. Claim 9 depends from claim 7 and requires that the sorbent is an acidic activated carbon. Claim 10, likewise depends from claim 7 and requires that the sorbent is an L type activated carbon.

Claim 11 depends from claim 9 and recites that the metal-coordinating compound is at least one of benzotriazole and benzothiazole. Claim 12 depends from claim 11 and further requires that the sorbent is an acidic activated carbon. Claim 13 also depends from claim 11 and further requires that the sorbent is an L type activated carbon.

Claim 14 recites including enclosing the sorbent and the metal-coordinating compound in a liquid permeable enclosure through which the acidic solution passes. Claim 15 further recites equilibrating the sorbent and the metal-

coordinating compound prior to enclosing in the liquid permeable enclosure. Applicants find no reasonably related teaching in the art of record with respect to these limitations and, further, find no discussion of these features in the outstanding rejections of the claims.

Claim 16 recites removing from the solution the metal-coordinating compound sorbed to the sorbent and the metal cations bound with the sorbed metal-coordinating compound. Applicants are unable to find any reasonable teaching with respect to these limitations in the art of record.

Claim 17 recites that the metal cations bind the metal-coordinating compound by each metal ion coordinating with a plurality of heteroatoms of the metal-coordinating compound.

Claim 18 requires that adding includes forming a combination of the metal-coordinating compound sorbed to the sorbent and, thereafter, introducing the combination into the solution. Applicants respectfully submit that the art of record is devoid of this feature in any reasonable combination.

Claim 19 requires that adding includes separately introducing each of the metal-coordinating compound and the sorbent to the solution. Claim 20 further requires that the metal-coordinating compound is introduced before the sorbent is introduced. Applicants respectfully submit that the art of record is devoid of any reasonable suggestion of these features in any reasonable combination.

Claim 21 recites that the metal-coordinating compound includes a ring selected from the group consisting of a triazole ring and a thiazole ring and the metal cations bind with said ring.

Claim 22 recites that the solution is aqueous and adding includes selecting a compound from the group consisting of a benzotriazole and a benzothiazole as the metal-coordinating compound.

Claim 23 recites that selecting is based, at least in part, on said specific pH.

Claim 24 recites that the metal cations include at least one member of the group consisting of an arsenic ion, a cadmium ion, a cobalt ion, a copper ion, a gold ion, an iron ion, a lead ion, a mercury ion, a nickel ion, a selenium ion, a silver ion, and a zinc ion and wherein the method includes selecting as the sorbent an activated carbon.

Claim 25 recites that (1) the metal cations which are bound with the metal-coordinating compound, and (2) the metal-coordinating compound sorbed to the sorbent form a complexation, and the method further requires removing the metal cations from the complexation to recover a base metal of the metal cations. Applicants respectfully submit that the art of record is not directed to base metal recovery in any reasonable way.

Claim 28 is an independent claim which recites introducing an amphipathic, heterocyclic metal-coordinating compound into the solution at the specific acidic pH, such that at least some of the metal cations bind with the binding compound. The solution is then exposed to a sorbent at the specific acidic pH, so that at least some of the metal-coordinating compound sorbs to the sorbent along with any metal cations bound therewith. To the extent that these

combined limitations reflect the limitations of claim 1, as discussed above, the arguments made with respect to the patentability of claim 1 over the art of record are equally applicable with respect to the patentability of claim 28. Accordingly for at least these reasons, allowance of claim 28 is respectfully requested.

Claim 29 depends directly from and therefore includes the limitations of claim 28. Accordingly, it is respectfully submitted that claim 29 is also patentable over the art of record for at least the reasons set forth above with respect to claim 28. Further, claim 29 places additional limitations on claim 28 which, when considered in its light, further distinguish the claimed invention from the art of record.

For example, claim 29 recites that exposing includes (i) enclosing the sorbent in a flow-through enclosure and (ii) causing the solution, including the metal-coordinating compound, to flow through the sorbent in the enclosure for sorbing the metal-coordinating compound and metal cations bound therewith. It is respectfully submitted that the art of record is devoid of this combination of features when viewed in any reasonable light.

Claim 30 is an independent claim which requires enclosing an amphipathic, heterocyclic metal-coordinating compound and a sorbent in a flow-through enclosure. The solution is caused to flow through the enclosure such that at least some of the metal cations bind with the binding compound at the specific acidic pH and at least some of the metal-coordinating compound sorbs to the sorbent at the specific acidic pH, in the enclosure, along with any metal cations bound therewith. To the extent that these combined limitations reflect the limitations of claim 1, as discussed above, the arguments made with respect to the patentability of claim 1 over the art of record are equally applicable with respect to the patentability of claim 30. Further, Applicants find no teaching in the art of record with respect to enclosing these specific materials in a flow-through enclosure. Accordingly for at least these reasons, allowance of claim 30 is respectfully requested.

Claims 31 and 32 each depend directly from and therefore include the limitations of claim 30. Accordingly, it is respectfully submitted that each of these claims is also patentable over the art of record for at least the reasons set forth above with respect to claim 30. Further, each of these dependent claims places additional limitations on their parent and intermediate claims which, when considered in light of claim 30, further distinguish the claimed invention from the art of record.

For example, claim 31 requires sorbing the metal-coordinating compound to the sorbent before enclosing the materials in the flow-through enclosure.

As another example, claim 32 recites equilibrating the metal-coordinating compound with the sorbent before enclosing.

Claim 33 is an independent claim which recites that (i) an amphipathic, heterocyclic, metal-coordinating compound and (ii) a sorbent, are added to a solution having a specific acidic pH and containing metal cations such that at least some of the metal-coordinating compound and at least some of the sorbent cooperate at the specific acidic pH to sequester at least some of the metal cations from the solution. To the extent that these combined limitations reflect the

limitations of claim 1, as discussed above, the arguments made with respect to the patentability of claim 1 over the art of record are equally applicable with respect to the patentability of claim 33. Accordingly for at least these reasons, allowance of claim 33 is respectfully requested.

Claim 34 is an independent claim which recites, in a solution having a specific acidic pH, that is contaminated with metal cations, binding at least some of the metal cations to an amphipathic, heterocyclic metal-coordinating compound, at the specific acidic pH, for subsequent use. In this regard, as discussed above, it is believed that Huang teaches nothing with respect to either contaminated solutions having an acidic pH or the use of an amphipathic, heterocyclic metal-coordinating compound. While the '428 patent teaches the use of a heterocyclic compound in applying a layer of photoresist to a substrate as a wetting agent, there remains no teaching with respect to the use of such compound in a contaminated solution in the manner that has been discovered by Applicants. Further, Applicants believe that there is no reasonable basis to support the proposed combination of references, as discussed above. Accordingly, for at least these reasons, allowance of claim 34 is respectfully requested.

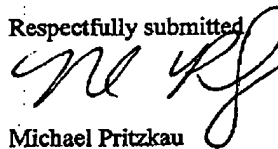
Claim 35 depends directly from and therefore includes the limitations of claim 34. Accordingly, it is respectfully submitted that claim 35 is also patentable over the art of record for at least the reasons set forth above with respect to claim 34. Further, claim 35 places additional limitations on claim 34 which, when considered in its light, further distinguish the claimed invention from the art of record.

For example, claim 35 recites sorbing at least some of the metal-coordinating compound and metal cations bound thereto using an activated carbon at the specific acidic pH. To the extent that the combined limitations of claims 34 and 35 reflect the limitations of claim 1, as discussed above, the arguments made with respect to the patentability of claim 1 over the art of record are equally applicable with respect to the patentability of claim 35. Accordingly for at least these reasons, allowance of claim 35 is respectfully requested.

For the foregoing reasons, it is respectfully submitted that all of the Examiner's objections have been overcome and that the application is in condition for allowance. Hence, allowance of these claims and passage to issue of the application are solicited.

If the Examiner has any questions concerning this case, the Examiner is respectfully requested to contact the undersigned at 303-410-9254.

Respectfully submitted



Michael Pritzkau  
Reg. No. 37,913